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Effectiveness of kinesio taping in bicipital tendinitis treatment: A randomized controlled trial

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Abstract
Aim: Biceps tendinitis is characterized by inflammation of the biceps long head, and treatment options include various conservative and surgical methods. Kinesiotaping (KT) has benefited in reducing pain and providing motor control in various shoulder disorders. The aim of this study is to investigate the effectiveness of KT application in patients with biceps tendinitis in terms of pain, pain threshold, upper extremity functionality level and quality of life.
Materials and Methods: Eighty patients with biceps tendinitis were divided into two groups randomly, each comprising 40 patients. The study group received KT with an exercise program, the control group received an exercise program only. Pre- and post-treatment evaluations were conducted. Pain threshold was evaluated with a digital algometer, pain severity with visual analog scale (VAS), functional capacity with the disabilities of the arm, shoulder and hand score (Q-DASH) and quality of life with Nottingham Health Profile (NHP).
Results: The mean duration of the symptoms was 4.5 months and the mean age was 45.80±8.48 years. Pain intensity decreased during activity ($p<0.001$) and pain thresholds increased ($p<0.001$) in the KT group. Q-DASH scores improved significantly in patients in the KT group, there was a less significance in the control group ($p<0.001$, 0.043). The NHP scores except social isolation improved in all sub-parameters of the KT group and there was no significance in control group ($p>0.05$, 0.003, 0.012, 0.023, 0.225, 0.035, 0.029, 0.006).
Discussion: KT application decreases pain and increases the functional capacity level and can also play a role in improving the general quality of life in biceps tendinitis treatment.

Keywords
Biceps tendinitis; Kinesio tape; Pain; Functional capacity; Quality of life

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Introduction

The prevalence of shoulder pain in the general population is between 7-26% and the lifetime prevalence reaches 67% [1]. Biceps tendinitis is characterized by inflammation of the long head of the biceps and is one of the most common pathologies causing shoulder pain. Studies specific to the definition of biceps tendinitis were first performed by Codman in 1934. It often occurs as a result of mechanical irritation and degeneration of the tendon due to subacromial compression, trauma or excessive use [2]. Although it is frequently accompanied by degenerative rotator sheath lesions or impingement syndrome, primary biceps tendinitis occurs in 5% of cases [3]. Although there is no specific test with reliable positive predictive value in the clinical evaluation of biceps tendinitis, anterior shoulder pain, sensitivity in the bicipital groove, and Speed and Yergason tests can be seen positively [4]. In palpation, while the arm is at 10 degrees internal rotation, it is determined by the pain felt at the pressure applied approximately 7.5 cm below the acromion in the anterior of the shoulder. Magnetic resonance imaging is valuable for evaluating the biceps tendon, bicipital groove, bone osteophytes, and fluid [5].

Nonoperative approaches are preferred in the treatment of biceps tendinitis. Treatment methods include physiotherapy, rest, activity modification, nonsteroidal anti-inflammatories, corticosteroid injections and surgical interventions. Conservative physiotherapy methods include many multimodal approaches such as exercise, joint and soft tissue mobilizations, electrotherapeutic and thermal applications. In terms of exercise approaches, eccentric and eccentric-concentric exercises are used most frequently in the treatment of tendinitis. Although eccentric exercises have shown beneficial effects in patients with tendinitis by stimulating and organizing collagen synthesis [6,7], in recent years, concentric and eccentric exercise components have been reported to provide a process defined as 'mechanotransduction' that accelerates tissue healing with mechanical loading [8].

Kinesiotape (KT) application is a treatment method that has been used since 2007 and has become one of the current physiotherapy approaches in recent years. KT applications are recommended in rehabilitation protocols because they reduce pain and provide motor control [9]. KT stabilizes the muscles and joints with its elastic acrylic adhesive structure. KT increases interstitial space by creating skin lifting effect in manually stretched structures, facilitates tissue regeneration, and accelerates lymphatic and venous flow. It reduces pain by creating decompression in subcutaneous nociceptors in connective tissue [9]. Although its efficacy has been observed in various patient groups, no study evaluating its efficacy has been found specifically in patients with biceps tendinitis [5,9,10].

The aim of this study is to investigate the effectiveness of KT application in patients with biceps tendinitis in terms of pain, pain threshold, upper extremity functionality level and quality of life. Our hypothesis is that KT method applied in addition to exercise in biceps tendinitis will be more useful than exercise alone.

Material and Methods

This randomized prospective controlled trial was designed, conducted and reported in accordance with the standards of the CONSORT (Consolidated Standards of Reporting Trials) statement. The approval of the Istanbul Bilgi University Clinical Investigations Ethics Committee was obtained, and the enrolled subjects signed a free and informed consent form.

The study included 80 patients diagnosed with bicipital tendinitis. Biceps tendinitis was diagnosed with the Speed test, the Yergeson test, tenderness on bicipital groove, and MRI evaluation. The patients were divided into two groups, each comprising 40 patients. Patients were randomized using randomization software and divided into two groups. A randomized list was prepared in a computer environment by a statistician for randomization. In this list, odd numbers were given to the control group and the KT group were given even numbers. The group identification was printed on sequentially numbered cards placed in sealed envelopes. After enrollment, the numbered envelope was opened by the patient and the blinded investigator. KT and exercise were given to the patients in the first group, and the only exercise was given to the patients in the second group. Nonsteroidal anti-inflammatory therapy was applied to all patients. The exclusion criteria were full-thickness rotator cuff tears, shoulder girdle fracture, glenohumeral dislocation/subluxation, acromioclavicular sprain, concomitant cervical spine symptoms, a history of shoulder surgery within the previous 12 weeks, or shoulder pain for longer than 6 months.

Exercise protocol: All patients performed exercises 5 days per week over a 6-week period in the physical therapy clinic. Firstly, 1-repeat maximum values of the patients were found. Later, patients were in the sitting position, while the arm was in adduction near the body, elbow flexion and extension were performed with a weight of 50% of the maximum repeat values. Each repeat was controlled to be completed in 2-3 seconds.

KT application: KT was applied twice a week, 12 times for a total of 6 weeks. KT was applied in combination with tonus reduction muscle application and fascia correction technique. In practice, 2 pieces of Y tape are used. The patient is seated in a resting position. The beginning of one of the tapes is applied below the inside of the elbow. The beginning of the tape is determined by shifting the skin. The 2 tails of the band surround the biceps brachii muscle body, then run parallel to the anterior edge of the deltoid muscle and end in the coracoid process. The beginning of the 2nd tape for fascia correction is in front of the pain point. The arm is in extension. The fascia is pulled in the transverse direction in the direction of the muscle fibers. It is pulled in the posterior direction to prevent compression of the biceps tendon. Tail tips are applied without tension (Figure 1).

Measurements were performed twice before and after the treatment for all patients. Pain threshold with digital algometer, pain severity with visual analog scale (VAS), disability level with the DASH Scale, quality of life with the Nottingham Health Profile (NHP) were evaluated before and after treatment.

Pain threshold: Algometer is a tool that measures pressure pain threshold and pain tolerance in quantitative sensory tests. Measurements were taken from the inferior medial part of the biseps. Firstly, the application was explained to the patients. The probe of the algometer was placed vertically on the skin and after pressure was given, patients were asked to indicate and

not try to withstand the first time they felt pain. The pressures at the time of the patients were measured. Measurements were performed 3 times giving rest intervals and their averages were recorded.

Pain severity: Pain severity was evaluated with VAS in activity. Participants were told how to do it and were asked to give a score between 0-100. Zero means no pain, 100 indicates severe pain.

Functional assessment: Upper extremity functional assessment was carried out with Q-DASH. Q-DASH is a regional result criterion that was developed for upper extremity musculoskeletal system disease. It evaluates all upper extremity functions, is filled out optionally and includes sport and musician modules. It contains eleven questions. To calculate the score of the criterion that can be used instead of Q-DASH, at least 10 questions out of 11 must be answered. Each question is graded on a 5-point- Likert scale. The total score of the questionnaire is calculated in such a way that the total number of points of the marked questions is divided by the number of questions marked, and then 1 is subtracted from the result, and the result is multiplied by 25. Point total between 0-20 indicates normal, 21-40 indicates slight, 41-60 indicates moderate, and 61-80 indicates severe disability. The business model investigation survey of Q-DASH contains 4 questions intended for the assessment of problems that the patient has with his/her arms while working. Difficulty level is scored between 1 and 5. The total score of the questions is divided by 4, then 1 is subtracted from the result and then this result is multiplied by 25. The validity and reliability of this scale was confirmed by Düger et al [11].

Quality of Life: The Nottingham Health Profile (NHP) was used to determine the quality of life of the participants. NHP is a general health status scale (health-related quality of life), which aims to measure a patient's perceived emotional, social and physical health status. This scale consists of 38 items formed as yes-no questions that cover 6 subscales of the quality of life. These six subscales are sleep (5 item), energy level (3 item), emotional status (9 item), social isolation (5 item), physical mobility (8 item) and pain (8 item). Each section is scored from 0 to 100. Zero indicates the best health status, 100 indicates the worst health status. In the study, the sub-scores of NHP and total NHP scores were evaluated. Total NHP score was obtained from the sum of the sub-scores. NHP is an easy-to-use scale and the validity and reliability of the Turkish version was confirmed by Küçükdeveci at al [12].

Statistical analyses were conducted using SPSS for Windows version 22.0 (SPSS, Inc., Chicago, IL, USA). Continuous and categorical data are reported as mean ± standard deviation and number (percentages), respectively. The Kolmogorov-Smirnov test was performed to determine the suitability of the data for normal distribution. After descriptive statistics were recorded, the Mann-Whitney U test was used for inter-group comparisons of nonparametric data, and the Wilcoxon test was used to compare groups before and after treatment. P- value £ 0.05 was accepted as significant for all statistical levels.

Results

Eighty patients with a mean age of 45.80 ± 8.48 years and a body mass index of 27.90 ± 4.57 kg / m² participated in the study; 62.5% of the patients in both groups were female and 37.5% were male. Biceps tendinitis was present in 61.9% of the patients in their right arm. There were no participants with biceps tendinitis in both arms. The mean symptom duration was 4.50±3.91 months since the onset of symptoms and the mean folllow-up period was 6.4 months (range 6-8 months). Demographic characteristics of the patients were similar (p>0.05) (Table 1).

Although the pain severity and pain thresholds of all patients were observed between the groups and within the groups, there was a statistically significant decrease in pain intensity (p<0.001) and significant increase in pain thresholds in KT group (p<0.001). No statistically significant difference was observed in the pain severity and pain thresholds of the patients in the control group after the treatment (p=0.889, 0.288). When the DASH scores were compared, it was observed that there was a statistically significant improvement in the functional level of the patients in the KT group (p<0.001), but there was a less significant improvement in the scores of the patients in the control group (p=0.043) (Table 2).

When the NHP results of the pre- and post-treatment patients were evaluated, significant improvement was observed in all sub-parameters except for social isolation of the KT group (p=0.003, 0.012, 0.023, 0.035, 0.029, 0.006, 0.225). No statistically significant change was observed in the parameters in the control group (p>0.05) (Table 3). In the comparison between the groups, all parameters of the NHP except sleep improved in the KT group (p=0.008, 0.026, 0.007, 0.008, <0.001, <0.001, 0.121) (Table 3). According to these results, KT application decreases pain and increases physical activity level but can also play a role in improving general quality of life.

Table 1. Demographic characteristics of patients

	KT group (n=40) Mean (SD)	Control group (n=40) Mean (SD)	p-value
Age (year)	45.76 (9.12)	45.87 (7.93)	0.913
BMI (kg/m²)	27.86 (4.68)	27.97 (4.70)	0.942
Duration of symptoms (month)	4.96 (4.21)	5.37 (4.95)	0.835

Mann-Whitney U Test. KT: Kinesiotape, BMI: Body Mass Index, SD: Standart deviation.

Table 2. Comparison of pre- and post-treatment pain threshold, pain severity, and disability results

	KT group Mean (SD)	Control group Mean (SD)	p-value[1]
Pain threshold (kg/cm2) Pre-T	8.28 (2.64)	10.38 (5.29)	0.384
Pain threshold (kg/cm2) Post-T	16.40 (2.07)	10.07 (3.62)	<0.001**
p2	<0.001**	0.889	
VAS Pre-T	6.53 (1.66)	6.25 (2.43)	0.853
VAS Post-T	1.15 (0.98)	4.50 (2.67)	<0.001**
p2	<0.001**	0.288	
Q-DASH Pre-T	50.75 (16.85)	45.45 (22.72)	0.612
Q-DASH Post-T	8.98 (8.17)	20.39 (14.56)	0.038*
p2	<0.001**	0.043*	

*p<0.05, **p<0.001. 1Mann-Whitney U Test; 2Wilcoxon Test. Pre-T: Pre-Treatment, Post-T: Post-Treatment, KT: Kinesiotape, VAS: Visual analog scale, Q-DASH: Quick Disabilities of the Arm, Shoulder and Hand, SD:Standart deviation.

Table 3. Comparison of pre- and post-treatment Nottingham Health Profile results

NHP values	KT group Mean (SD)	Control group Mean (SD)	p[1]
NHP Pain Pre-T	51.47 (29.95)	48.38 (26.54)	0.573
NHP Pain Post-T	15.05 (20.29)	44.97 (31.48)	0.008*
p2	0.003*	0.249	
NHP Emotional reaction Pre-T	38.16 (27.67)	38.61 (29.49)	0.927
NHP Emotional reaction Post-T	16.99 (28.07)	29.97 (18.85)	0.026*
p2	0.012*	0.091	
NHP Sleep Pre-T	43.90 (31.83)	30.91 (28.80)	0.139
NHP Sleep Post-T	16.47 (27.01)	28.46 (25.81)	0.121
p2	0.023*	0.686	
NHP Social isolation Pre-T	15.81 (24.63)	17.81 (21.12)	0.491
NHP Social isolation Post-T	5.21 (15.98)	20.07 (25.69)	0.007*
p2	0.225	1.000	
NHP Physical abilities Pre-T	29.54 (16.99)	30.53 (19.02)	0.951
NHP Physical abilities Post-T	14.46 (21.64)	31.81 (21.42)	0.008*
p2	0.035*	0.398	
NHP Energy level Pre-T	56.84 (35.11)	66.94 (38.83)	0.325
NHP Energy level Post-T	25.57 (32.58)	71.03 (33.79)	<0.001**
p2	0.029*	0.441	
NHP Total score Pre-T	235.73 (111.85)	233.21 (111.46)	0.879
NHP Total score Post-T	93.79 (122.71)	226.32 (110.02)	<0.001**
p2	0.006*	0.552	

*p<0.05, **p<0.001. 1Mann-Whitney U Test; 2Wilcoxon Test. Pre-T: Pre-Treatment, Post-T: Post-Treatment, KT: Kinesiotape, NHP: Nottingham Health Profile, SD:Standart deviation.

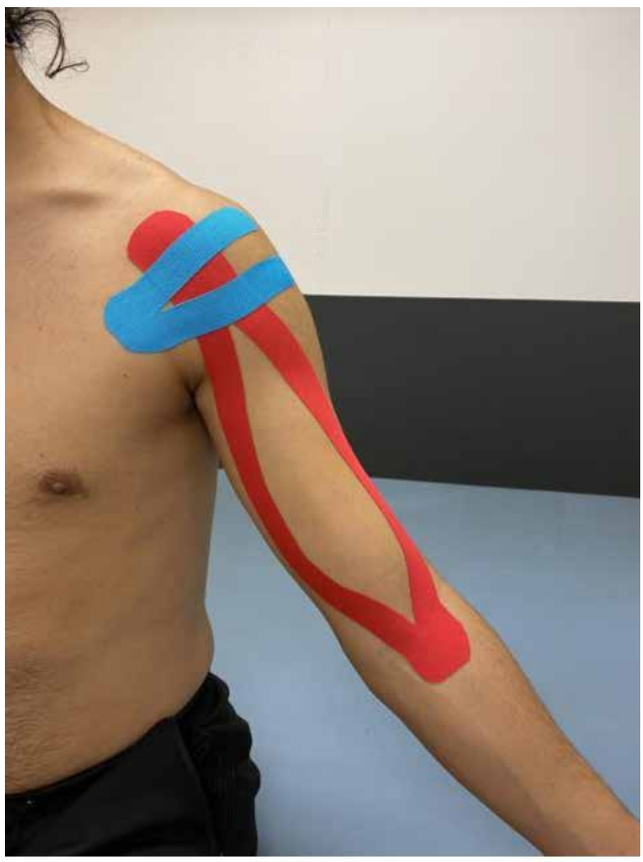

Figure 1. KT application

Discussion

This randomized controlled prospective clinical trial is the first study in the literature to demonstrate the effectiveness of the KT method used in the treatment of patients with biceps tendinitis on pain, pain threshold, functionality and quality of life. As a result of our study, it was found that KT application applied in addition to exercise therapy was effective in reducing pain severity, increasing pain threshold, functional level and quality of life.

The long head of the biceps depresses the humerus head, providing stabilization in the glenohumeral joint. In cadaveric studies, contractions in which the biceps long head was stimulated significantly decreased anterior, superior, and inferior translation at the shoulder. In biomechanical analysis, the biceps long head has been shown to provide anterior stabilization of the glenohumeral joint during abduction and external rotation. In another cadaver study, Rodosky et al. found that when stimulating the biceps long head, the biceps muscle creates resistance against shoulder abduction and external rotational torsional force [13]. For these reasons, there is a significant limitation in shoulder functions in cases caused by pathological changes in the biceps tendon [5].

Treatment of biceps long head tendinitis often starts with non-surgical methods, as with most tendon conditions. Conservative treatment includes activity modification and non-steroidal anti-inflammatory therapy. Physical therapy applications are organized for scapular rhythm and accompanying shoulder pathologies. Studies have shown that tendons can respond to controlled loading after injury. In the systematic review by Malliaras et al., they reported that eccentric-concentric loading can be used alone or only instead of eccentric loading in tendinopathies [14]. The mechanism for the effectiveness of this exercise method is explained by loading the tendon resulting in localized tendon remodeling and tensile strength and providing lengthening in the neck. Therefore, in our study, we applied eccentric-concentric exercise combination to all our patients as exercise.

KT has been used in shoulder pathologies since 2007. Most of these studies include impingement syndrome and rotator cuff injuries. Specifically, there is no study with KT applied in biceps tendinitis. The KT is stated to have four basic functions in the tissue, including supporting the muscles, reducing the obstruction in the flow of body fluids, stimulating the endogenous analgesic system and correcting joint problems [15,16]. The most important feature of the KT is that it adapts to the flexing capacity of skin [15]. The tape minimises skin irritations and imparts greater elasticity to the skin. Its structure is similar to that of the epidermis layer of skin due to its thickness and weight. It can adapt to the tension and relaxation of the skin with movement, mimicking its thickness and flexibility. It has an elastic structure that allows it to stretch by 130%–140% of its original length [16]. Lim and Tay explained the effect of KT on pain reduction with neurophysiological and mechanical mechanisms [17]. According to these mechanisms, KT provides inhibition of the transmission of nociceptive signals, stimulates pain-reducing inhibitory mechanisms and reduces the pressure in subcutaneous nociceptors [17]. Shakeri et al. reported that the pain intensity decreased during movement immediately

after the KT application [18]. Kaya et al. and Şimşek et al. compared the short-term results of KT and placebo KT in shoulder impingement syndrome, and found a reduction in pain with KT treatment [20,21]. Wilk et al. reported that KT may be beneficial in reducing symptomatic pain and pain during activity in biceps tendinitis [5]. Thelen et al. showed that half of 42 patients with rotator cuff tendinitis were treated with KT and the other half received the placebo treatment, which resulted in pain-free shoulder abduction in the short term. However, they reported that it had no effect on pain functionality in the long term [10]. Kaya et al. divided patients with subacromial impingement syndrome into 2 groups, and applied KT and exercise to one group for 6 weeks, and manual therapy and exercise to the other group. In both groups, they did not find any difference between the groups seeing improvement in pain and disability [18]. Reynard et al. found that after KT application of rotator cuff surgery, compared to the placebo group, the KT has no clinical benefit on shoulder joint range of motion, pain, and muscle strength [9]. In our study, we found that KT treatment has beneficial results in the short term in terms of pain and functional scores in patients with biceps tendinitis. For better evaluation of patients with biceps tendinitis and to show treatment results, we did not include patients with full-thickness rotator cuff tears.

Benefits of KT include increase in the functionality in the joints by providing the correct alignment, development of the joint position feeling and kinesthetic awareness. There are researches reporting that KT enhances upper extremity functionality and quality of life in shoulder pathologies [9]. Oliveira et al. divided 52 patients with rotator cuff tendinopathy into 2 groups. For 6 weeks, they applied only one rehabilitation program to one group and KT to the other group twice a week in addition to the rehabilitation program. They reported that symptoms and functional limitations decreased in their evaluations with DASH after 3 months and 6 months after treatment [22]. Frassanito et al. performed treatment of rotator cuff calcific tendinopathy only with ESWT in half of 42 patients and ESWT with KT in the other half. They reported greater improvement in the group that applied KT when they evaluated pain with VAS in short, medium, and long term, and disability with DASH [23]. It is thought that KT provides this healing effect by providing biomechanical correction in the joint, increasing neurological activation in muscles, decreasing wrong positioning and mechanical stress [19]. Miccinilli et al. reported that the KT applied to patients with rotator cuff tendinopathy decreases pain, increases functional recovery and muscle strength, but there is not enough evidence for KT application, and randomized controlled studies with larger groups are needed [24].

Among the limitations of the study, the first is that the diagnosis of biceps tendinitis cannot be made using arthroscopic method. Due to the fact that the diagnosis and treatment of all patients are performed by non-invasive methods, arthroscopic diagnosis has not been made. However, it has been stated in the literature that clinical diagnostic tests and magnetic resonance imaging are sufficient for diagnosis in the diagnosis of biceps tendinitis [4]. Another limitation of the study is the short follow-up time.

As a result, in our study, the application of kinesio tape in addition to exercise therapy in biceps tendinitis has been shown to provide significant benefits in terms of both pain and functionality. Larger patient groups and longer follow-up clinical studies are needed to investigate the efficacy of KT application in biceps tendinitis and other shoulder pathologies.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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